Remarks

In view of the above amendments and the following remarks, reconsideration of the outstanding office action is respectfully requested.

Initially, applicants note that claims 1-17 remain pending, claims 18-19 have been cancelled without prejudice, and new claims 20-21 have been introduced.

The objection to the specification as lacking an abstract is overcome by the above amendment ordering entry of the appended Abstract of the Disclosure.

The objections to claims 1-19 are overcome by the above amendments to claims 1 and 2.

The rejection of claim 8 under 35 U.S.C. § 112 (second paragraph) is overcome by the above amendment thereto.

Prior to dealing with the various rejections made over the art of record, applicants respectfully submit that it would be helpful to review the invention as set out in the specification.

The invention, as described on page 2 of the specification, builds on a previous invention of the applicants (*see* PCT Application Publ. No. WO 96/38186 to Melrose et al. ("Melrose")) in which it was found that poly(2-propenal, 2-propenoic acid) is formed when aldehyde groups of poly(2-propenal) are partially auto-oxidized to carboxylic acid groups by heating the compound (generally a solid) in air. The present invention relates to the finding that the antimicrobial activity and stability of the polymers is significantly enhanced (i.e., the polymers are super activated), by heating these partially oxidized polymers in a solution containing an alcohol solvent and water.

This finding was completely unexpected and indeed arose from tests carried out by applicants to simulate accelerated aging of the polymer. This is explained on page 5, lines 20 to 27 of the present application. To the surprise of the applicants, the oxidized polymers not only aged well but developed superior antimicrobial activity and stability. This superior activity and stability is now believed to be due to formation of acetal groups (*see* page 6, lines 16 to 20) which form upon sustained heating of the oxidized acrolein polymer with alcohols

(particularly polyalkylene glycols). As explained on page 6, lines 16 to 20, the formation of acetals may protect the polymers from alkaline degradation by the cannizarro reaction.

Some of the documents cited by the U.S. Patent and Trademark Office ("PTO") in the outstanding office action relate to the formation of polyacrolein polymers by processes that involve heating acrolein monomer and polymerization initiators in aqueous alkali. However, none of the documents cited by the PTO suggest forming an air-oxidized acrolein polymer by heating the solid in air to form carboxylic acid groups, providing a solution of the air-oxidized acrolein polymer in a mixture containing water and an alcohol, and then heating the solution at a temperature in the range of from 40 to 150°C such that the antimicrobial activity of the treated acrolein polymer is improved. Indeed, none of the references in any way suggest that such a step would be useful in providing improved antimicrobial activity.

Finding improvement in antimicrobial activity and stability by heating under these conditions was indeed surprising, as heating under these conditions was expected to provide accelerated aging. The improved antimicrobial activity under the conditions claimed is clearly demonstrated in the examples of the present invention. As explained above, the preparation of the starting material in accordance with Melrose is demonstrated in Example 1 and the super activation process which is the subject of claim 1 is demonstrated in the remaining examples.

In Example 2, the heating of a composition of the poly(2-propenal, 2-propenoic acid), the oxidized acrolein polymer, in polyethylene glycol and sodium carbonate at 60°C for a period of 12 or 25 days provides a significant improvement in antimicrobial activity when compared with a similar composition retained at room temperature. Example 7 further demonstrates the super activation process under a range of temperature conditions and time periods for activation.

Table 8 in Example 6 also demonstrates that the content of free acrolein monomer in the composition is reduced during super activation, giving rise to less contaminant acrolein monomer. This is a particularly important finding because acrolein monomer is a source of tissue and dermal irritation. Thus, contrary to the expectation, a *reduction* in the release of acrolein, which is considered by Werle et al. (references cited below) to be responsible for activity, actually accompanied the *increase in activity*.

The rejection of claims 1, 2, 5-10, and 12-19 under 35 U.S.C. § 102(b) as anticipated by Australian Patent Application No. AU 11686/95 to Werle et al. ("Werle I") is rendered moot with respect to the cancellation of claims 18 and 19, and is otherwise respectfully traversed.

Werle I is candidly discussed in the present application at page 2, lines 11 to 15, and at page 7, lines 2 to 8. Example 5 of the present application also compares the present invention with the process of Werle I.

Werle I teaches a method for preparing polyacrolein in which acrolein monomer and a catalyst are added to a reaction vessel and the temperature does not exceed 25°C (*see* abstract). Werle I also teaches that the product may be readily dissolved in polyhydric alcohols, but does not teach or suggest a process in which the polymer is oxidized in air and then heated as recited in claim 1 (i.e., to improve antimicrobial activity). Indeed, in view of the fact that the polymers are readily soluble, there would be no reason to heat them with the apparent risk of accelerated degradation. Example 2 of Werle I discloses the preparation and then precipitation of a polyacrolein. Example 3 of Werle I combines the polyacrolein product with peroxide solution at 70 to 75°C, which is reported to provide improved water solubility. Example 4 of Werle I discloses polyacrolein that is dried in a fluidized bed, and in one case is heated at 75°C for 3 hours. Example 5 of Werle I discloses dissolving the dried polyacrolein in ethylene glycol and then combining the alcohol solution with NaOH or $NaOCH_3$, followed by pouring the solution into water (i.e., as a test of water solubility). There is, however, no disclosure of a process of heating air-oxidized polymer in a water/alcohol solution for a period sufficient to improve antimicrobial activity. Indeed, the distinction between Werle I and the present invention is clearly demonstrated in Example 5 of the present application.

Applicants respectfully disagree with the characterization of the Examples in Werle I, which are made at pages 3-4 of the outstanding office action. In particular, the PTO suggests that Examples 2-3 of Werle I disclose a process per the requirements of the presently claimed invention. As explained above, however, Example 3 of Werle I discloses oxidizing the acrolein polymer in peroxide solution, which is said to give greater solubility. Importantly, the material that is heated in peroxide solution has not been *oxidized in air* to form carboxyl groups.

Further, the composition "post-oxidation" with peroxide is not heated in a solution containing water and an alcohol solvent, and there is no report of improved antimicrobial activity.

In contrast to the teachings of Werle I, the invention of claim 1 recites a method for improving the antimicrobial activity of a polymer derived from acrolein monomer wherein the polymer has been oxidized in air to form an oxidized acrolein polymer comprising carboxyl groups, i.e., poly(2-propenal, 2-propenoic acid). The method of claim 1 recites the steps of: "providing a solution of the oxidized acrolein polymer comprising carboxyl groups in a mixture containing water and a solvent comprising an alcohol selected from the group consisting of polyols, polyethylene glycols and alkanols" and then "heating the solution at a temperature in the range of from 40 to 150°C for a period sufficient to improve the antimicrobial activity of the acrolein polymer."

As noted above, heating of the composition for a sufficient period results in a remarkable improvement in activity and an improvement in stability as is evident from the reduced presence of acrolein monomer. Nowhere does Werle I teach the process as presently claimed, let alone the result of the process as recited in claim 1.

For these reasons, Werle I cannot anticipate the invention of claims 1, 2, 5-10, and 12-17. Therefore, the rejection is improper and should be withdrawn.

The rejection of claims 1, 2, 5-9, and 12-19 under 35 U.S.C. § 102(b) as anticipated by Australian Patent Application No. 711548 to Werle et al. ("Werle II") is rendered moot with respect to the cancellation of claims 18 and 19, and is otherwise respectfully traversed.

Werle II teaches a process for *preparing* a copolymer of alcohol and acrolein, rather than a process for treating previously air-oxidized polyacrolein. Werle II, as acknowledge by the PTO at page 4 of the outstanding office action, teaches the preparation of the copolymer using a polyhydric alcohol and acrolein in a medium substantially free of water. Moreover, it is important to note that the product of Werle II is intended to release acrolein from copolymer introduced into aqueous medium.

In striking contrast, the present invention uses an acrolein polymer which has been oxidized in air and involves a process of heating the oxidized acrolein polymer in a mixture containing water and an alcohol solvent to afford a product that is characterized by improved antimicrobial activity. There is no teaching in Werle II that the resulting acrolein-containing copolymer product should be heated in air to form carboxylic acid groups (i.e., poly(2-propanal, 2-propenoic acid)), let alone that the resulting product thus formed could be activated by heating the same in a mixture containing *water and an alcohol* solvent as recited in claim 1.

Furthermore, and with respect to claim 17, the specification recites that the presently claimed process is believed to activate and stabilize the polymer *against* the release of acrolein (*see* page 5, lines 12-18; page 6, lines 21-22). The finding by applicants that antimicrobial activity can be increased while also *reducing* release of acrolein monomer is contrary to the teachings of Werle II. This is particularly relevant, because acrolein monomer can cause an adverse reaction in tissues and membranes.

For all these reasons, Werle II cannot anticipate the invention of claims 1, 2, 5-9, and 12-17. Therefore, the rejection is improper and should be withdrawn.

The rejection of claims 1, 2, 5-10, 12, 13, and 16-19 under 35 U.S.C. § 102(b) as anticipated by Melrose is rendered moot with respect to the cancellation of claims 18 and 19, and is otherwise respectfully traversed.

Melrose, as discussed above, discloses a process of making polyacrolein rather than a process for treating previously air-oxidized polyacrolein. In particular, Melrose teaches making acrolein polymer by mixing an aqueous solution of hydroxide, methanol and acrolein, and heating the mixture to 60-65°C. Melrose indicates, at Example 1 part (a), that the solution is purged with nitrogen and conducted under an atmosphere of nitrogen. This procedure, while preparing polyacrolein, does not result in preparation of an oxidized polyacrolein.

Melrose, at Example 1 part (b), does discloses a process in which the product can be "carefully heat-dried in contact with ample air... at temperatures up to about 100°C." The air-oxidation gives rise to carboxyl groups. This disclosure is candidly discussed in the present application on page 2, lines 5 to 10.

Thus, Melrose discloses an air-oxidized polyacrolein, which is a *starting* material for performance of the presently claimed invention.

However, nowhere does Melrose teach or suggest that the steps of the present invention, which include heating a solution of an oxidized polyacrolein (containing carboxyl groups) in a mixture containing water and an alcohol solvent, can lead to formation of compounds having increased antimicrobial activity and increased stability. Neither the conditions which lead to the improvement nor the resulting product are in anyway suggested by Melrose.

For these reasons, Melrose cannot anticipate the invention of claims 1, 2, 5-10, 12, 13, 16, and 17. Therefore, the rejection is improper and should be withdrawn.

Although applicant respectfully disagrees with the rejection of claims 18-19 under 35 U.S.C. § 102(e) as anticipated by, or alternatively under § 103(a) for obviousness over, U.S. Patent No. 5,917,094 to Werle et al., the cancellation of these claims without prejudice renders the rejection moot.

In view of all of the foregoing, applicant submits that this case is in condition for allowance and such allowance is earnestly solicited.

Respectfully submitted,

Date: February 2, 2004

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